



International Association  
for Hydro-Environment  
Engineering and Research

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Spain Water and IWHR, China

From the Myths of Hercules to the reality  
of climate change  
Webinar 26-27 November 2020

# Climate Change adaptation strategies in Water engineering

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# Contribution from the IAHR TC on Climate Change Adaptation

✓ The IAHR white paper on climate change

<https://static.iahr.org/upload/file/20200803/1596445173675976.pdf>

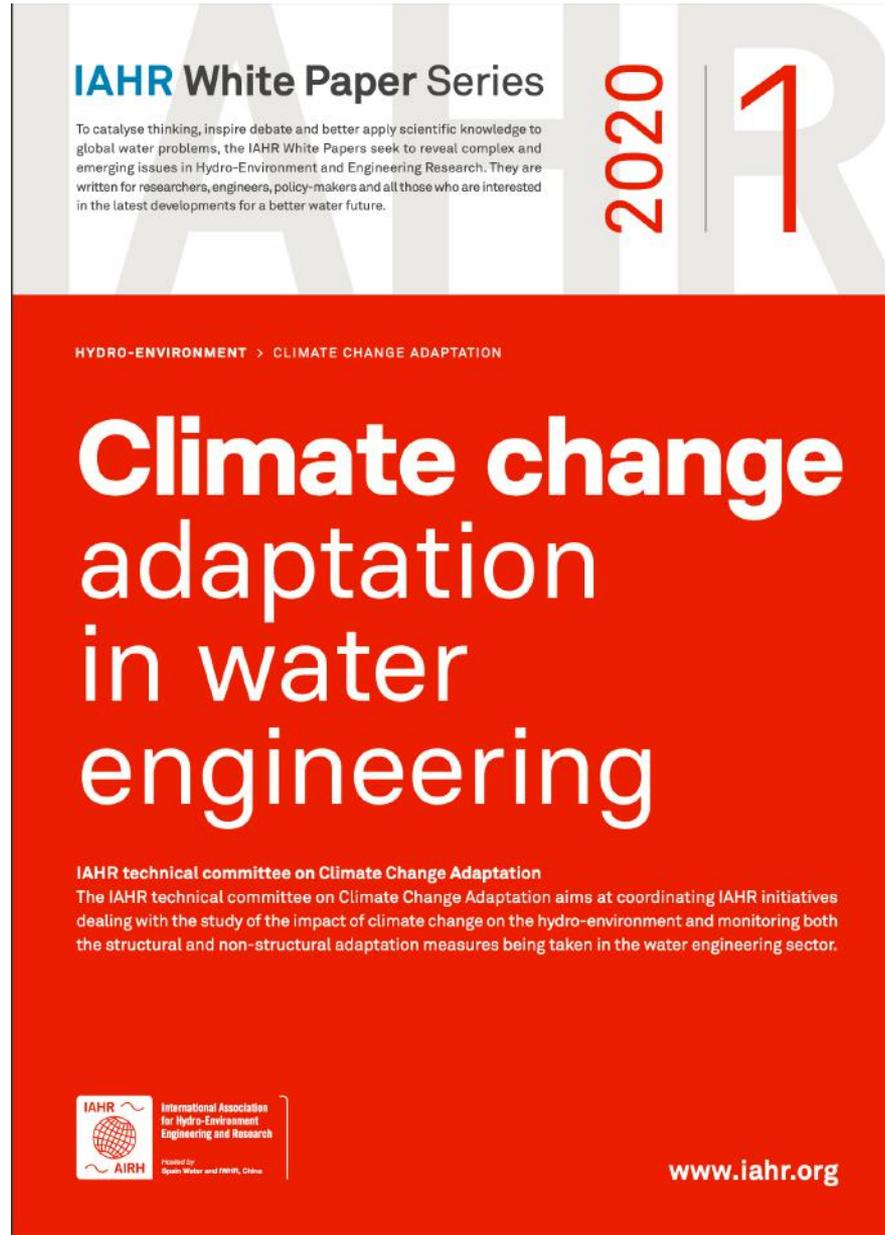
<https://www.iahr.org/index/detail/60>

□ **The IAHR Monograph on**

**Hydraulic Design guidance in a changing climate**

Scheduled for June 2022 IAHR Congress Granada

# ✓ The IAHR white paper on climate change



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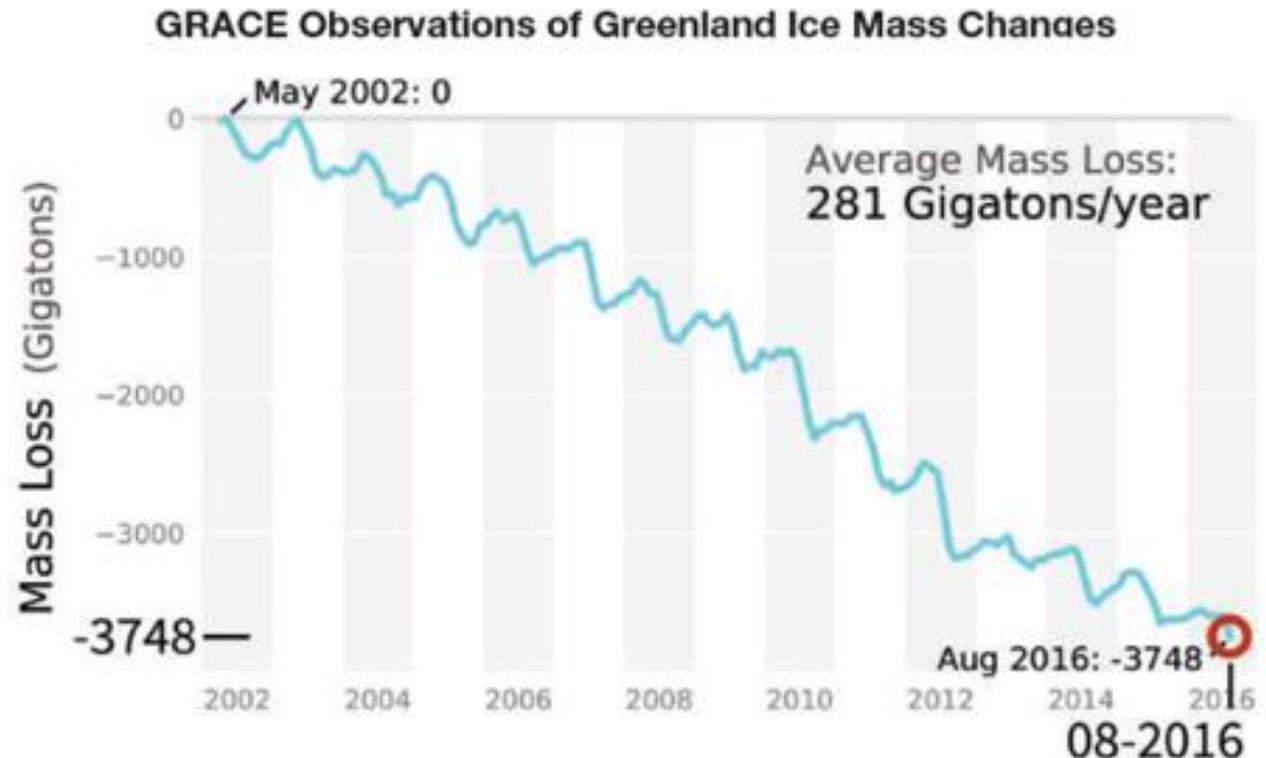
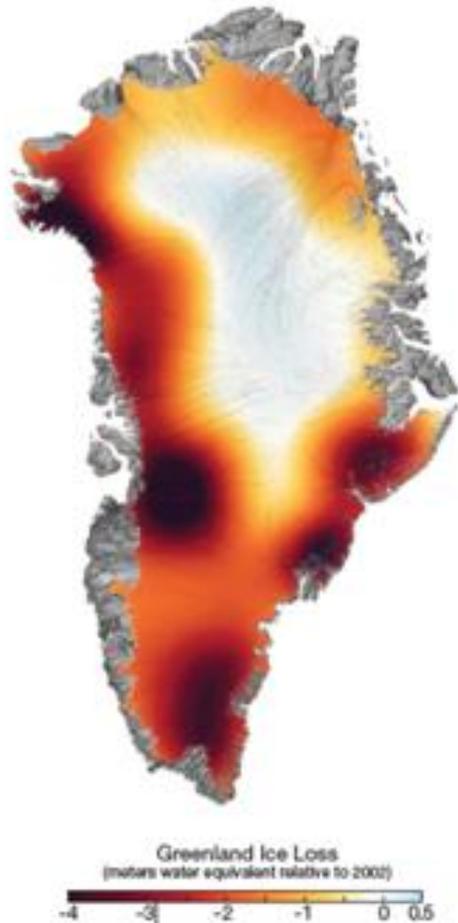
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[www.iahr.org](http://www.iahr.org)

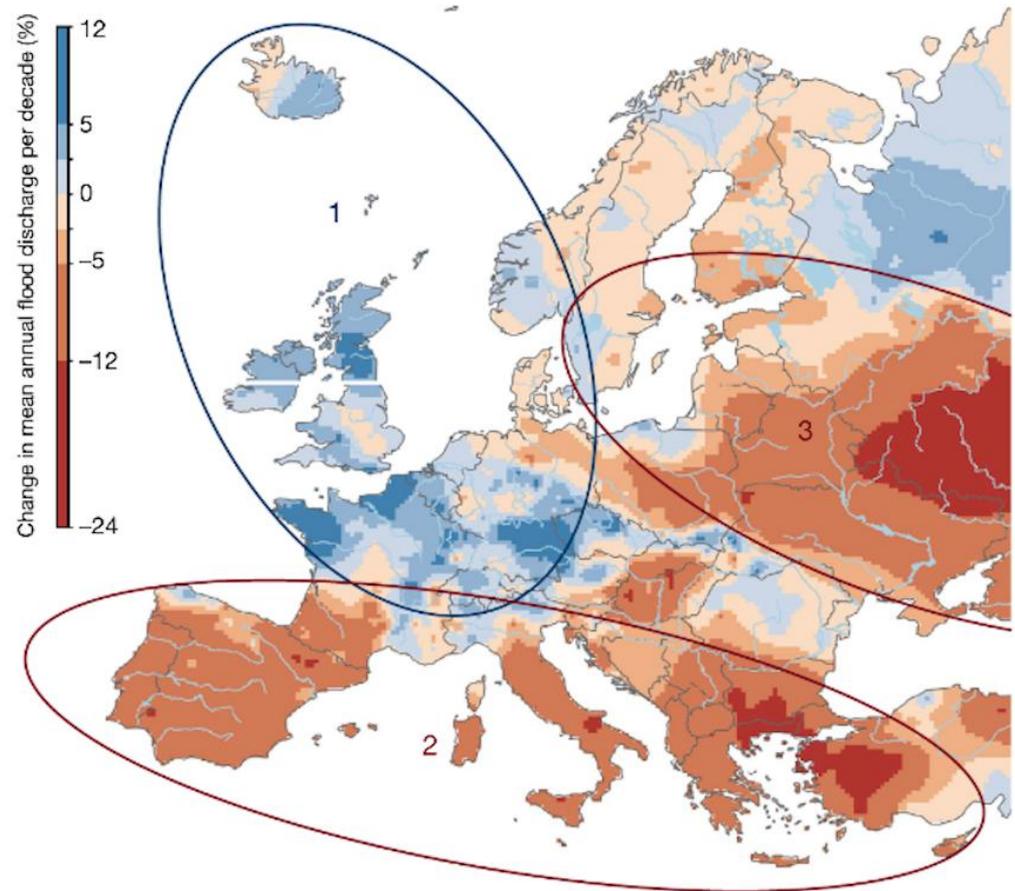
Little doubt exists about the impact Climate Change is having on **some components** of the hydrosphere

Observed Greenland Ice Mass Changes after gravimetric GRACE measurements corresponding to 8 cm/century Sea Level Rise (NASA, The Earth Observer, 30 (3), 2018)



However the impact of global warming on the water cycle shows high regional variability, **due to the combination of climatic and anthropogenic forcing**, for instance in

Flood **intensity** and timing ...



**Fig. 1 | Observed regional trends of river flood discharges in Europe (1960–2010).** Blue indicates increasing flood discharges and red denotes decreasing flood discharges (in per cent change of the mean annual flood discharge per decade). Numbers 1–3 indicate regions with distinct drivers. 1, Northwestern Europe: increasing rainfall and soil moisture. 2, Southern Europe: decreasing rainfall and increasing evaporation. 3, Eastern Europe: decreasing and earlier snowmelt. The trends are based on data from  $n = 2,370$  hydrometric stations. For uncertainties see Extended Data Fig. 2b.

# The need of scientifically sound data made available on public scientific repositories: the water community needs more efforts worldwide as done in the community of meteorology and climatology

## Example: daily runoff for Adda river 1845-2016



**PANGAEA.**

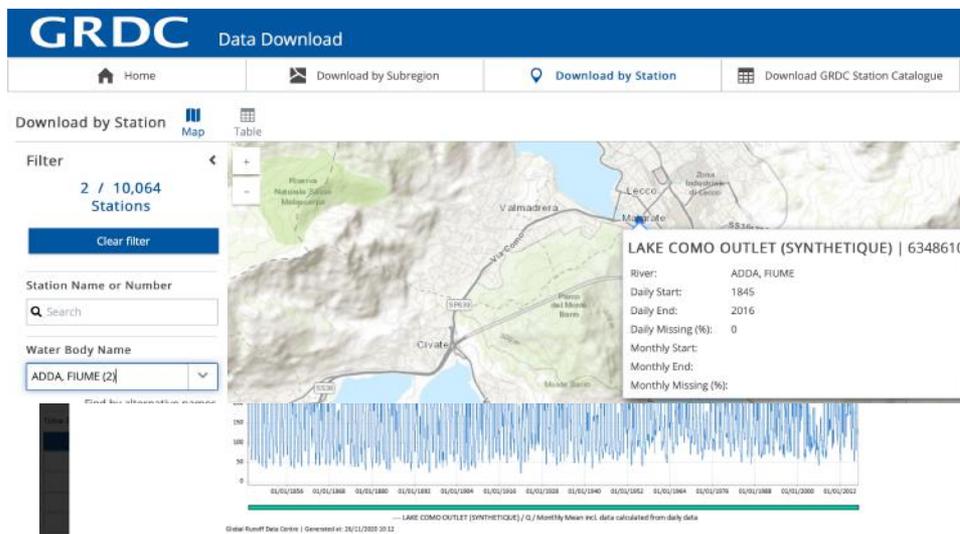
Data Publisher for Earth & Environmental Science

SEARCH SUBMIT ABOUT CONTACT

**Ranzi, Roberto; Michailidi, Eleni Maria; Tomirotti, Massimo; Crespi, Alice; Brunetti, Michele; Maugeri, Maurizio (2020):** Multi-century (1800-2016) meteo-hydrological series for the Adda river basin (Central Alps). *PANGAEA*, doi <https://doi.org/10.1594/PANGAEA.919890>

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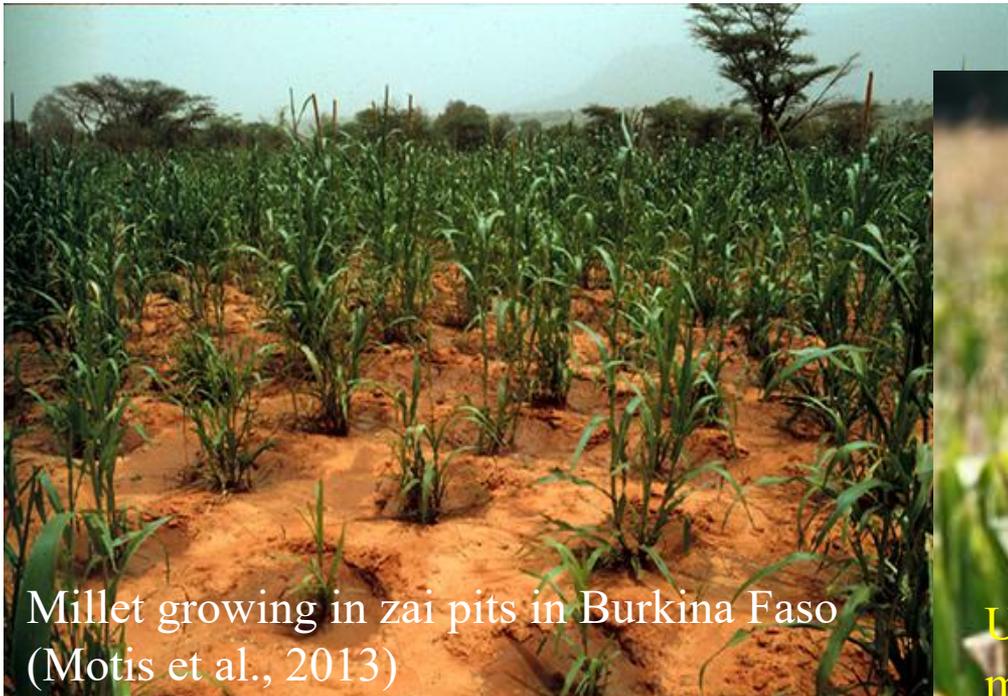
Global Runoff Data Center  
[portal.grdc.bafg.de](http://portal.grdc.bafg.de)

**Water engineering can provide guidance most on adaptation  
than on mitigation measures**

**Water – agriculture and soil conservation**

**Higher efficiency in use of water in agriculture**

**We need to blend advanced technologies (as UAV and satellites)  
with traditional irrigation systems for a sustainable water-  
efficient agriculture.**

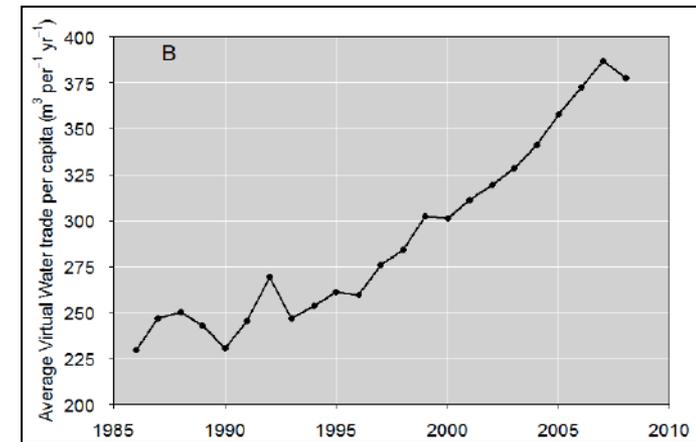
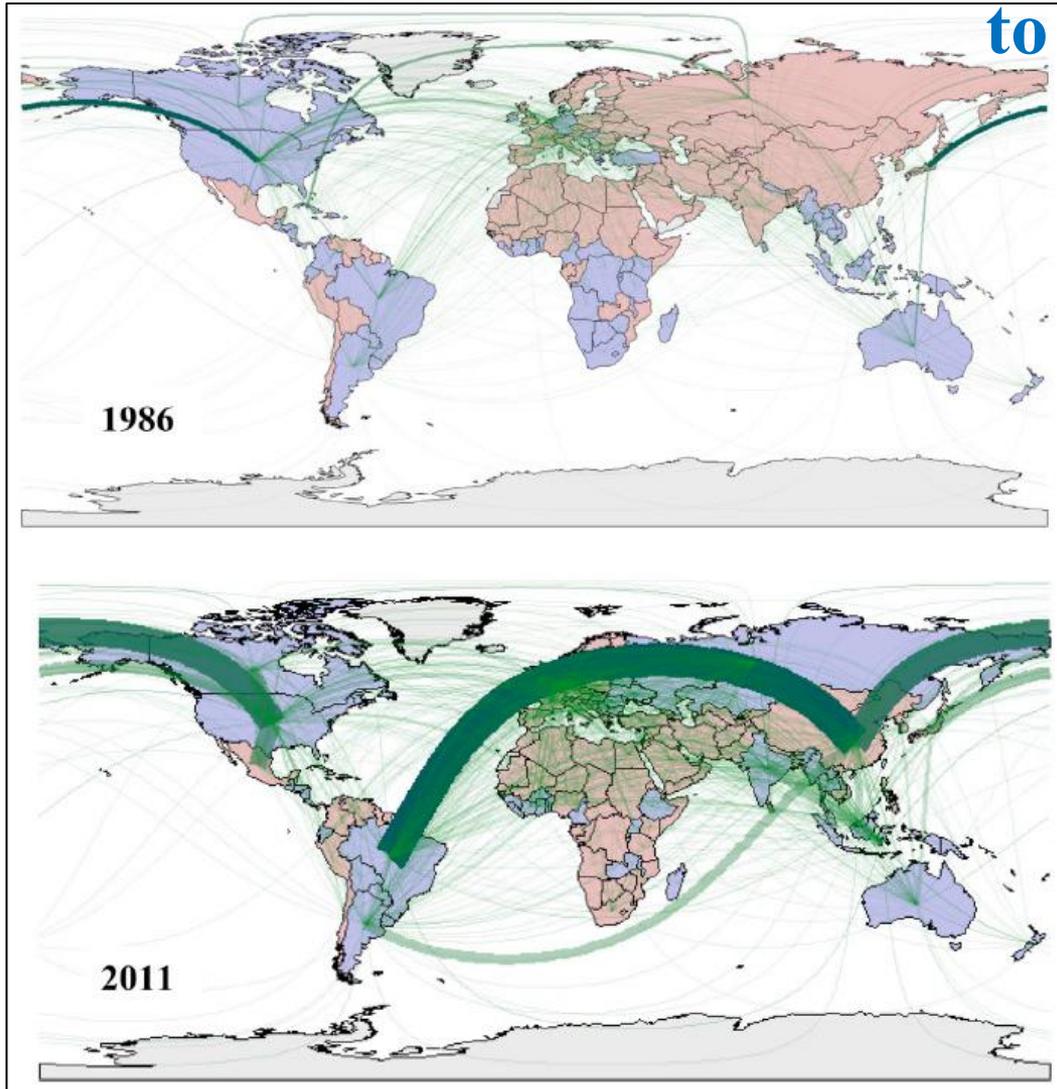


Millet growing in zai pits in Burkina Faso  
(Motis et al., 2013)



Use of UAV in agriculture to optimise  
microirrigation

# The VWT-Virtual Water Trade i.e. the trade of food and goods produced in areas rich of water toward countries affected by water scarcity, paying attention to socio-economic impacts



D'Odorico et al.  
Global virtual water trade and the hydrological cycle: patterns, drivers and socio-environment impacts. *Environmental Research Letters*, 14 (053001), 2019.

# Combination of ‘grey’ and ‘green’ Nature Based Solutions

The adaptation to the observed and projected changes on the water cycle has to be based on a combination of up-to-date traditional ‘grey’ engineering and ‘green’ Nature Based Solutions, for instance in coastal defence (Venice barriers, Sand Motor artificial nourishment, mangrove forests) and in regenerating ‘sponge’ cities (infiltration trenches, green roofs, riparian buffer strips, infiltration tanks, ...) more resilient to floods and heat -waves

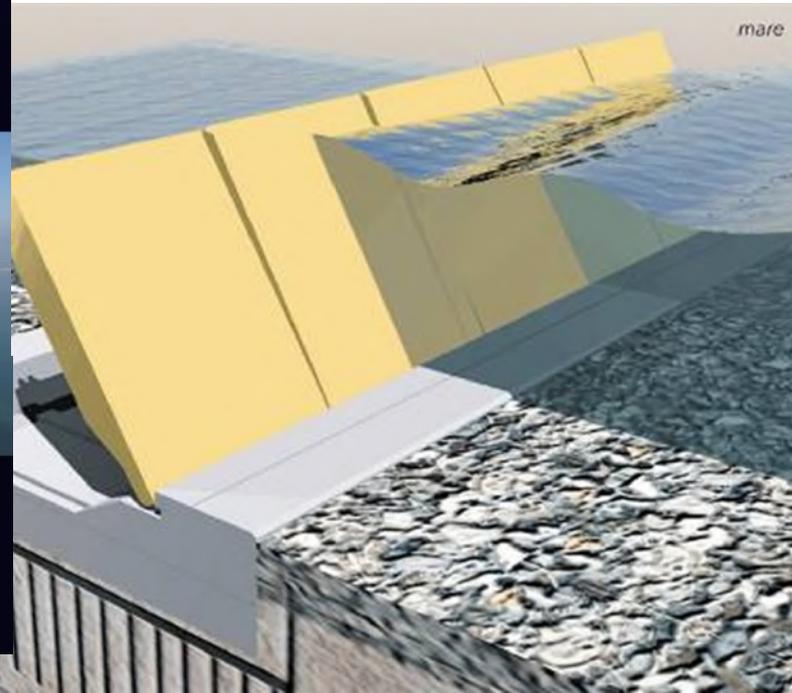
*Chang & Mori,  
Engineering  
functional  
evaluation of  
mangrove forests  
for coastal  
disaster  
reduction,  
Hydrolink, 4/2019*



A mangrove forest on the edge of a remote island in Raja Ampat, Indonesia (gettyimages)

# Adaptation & Resilience: the Venice MOSE barrier 'traditional hard' engineering completed, operation successfully tested 14.VII.2020, 3.X.2020

<https://youtu.be/bdMOOTt9Z7Q>



# Adaptation in water engineering design

Funding agencies as the World Bank Group<sup>1</sup> and the Asia Development Bank<sup>2</sup> request more and more frequently that climate change scenarios be included in the engineering design of large water projects

Because of the observed regional variability a consensus is being searched between scientists and professionals on how to upgrade design criteria of water infrastructures including climate change scenarios

IAHR is preparing a Monograph on



**Water engineering design guidance in a changing climate**

<sup>1</sup> Asian Development Bank, Guidelines for Climate Proofing Investment in the Energy Sector, Manila, 2013.

<sup>2</sup> World Bank Group, Action Plan on Climate Change. Adaptation and Resilience, Washington DC, 2019.



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# Conclusions

- The impact of CC on the water cycle is evident, although regional variability is high
- Consensus between scientists and professionals in water engineering design is being searched
- Combination of 'grey' and 'green' Nature Based Solutions for adaptation is needed
- Blending advanced technologies with traditional irrigation systems for a sustainable agriculture to combat challenges posed by climate change, population growth, trade regulation and food security.
- *This and more on the IAHR White paper and Monograph*